CLAIMS

1. A method for producing an adaptive directional signal, including the step of constructing the adaptive directional signal from a weighted sum of a first signal having an omni-directional polar pattern and a second signal having a bi-directional polar pattern, wherein the weights are calculated to give the combined signal a constant gain in a predetermined direction and to minimise the power of the combined signal.

2. A method according to claim 1 wherein the weights are calculated in a non-iterative manner.

3. A method according to claim 1 or claim 2, wherein the constant gain is provided by imposing a constraint that the first signal weight and the second signal weight add to a predetermined value.

4. A method according to claim 2 or claim 3 wherein the weights are calculated by solving the following equation:

$$a = \frac{\sum y^2 - \sum xy}{\sum x^2 - 2\sum xy + \sum y^2}$$

Where:

a = weight for the first signal

(1-a) = weight for the second signal

x = first signal sample

y = second signal sample.

5. A method according to any preceding claim, wherein said signal weights are calculated for a series of frames, each frame having a predetermined length consisting of N first signal samples and N second signal samples.

6. A method according to claim 5 wherein N=64.

7. A method according to claim 5 or claim 6, further including the step of filtering or smoothing the series of weights to minimise frame-to-frame variation in the calculated weights.

8. A method according to any one of claims 1 to 4, wherein the first and second signals are sampled, the weights being calculated for successive sets of said first and second signals samples.

9. A method according to claim 8 insofar as dependent on claim 4, wherein the weights are calculated continuously by calculating x^2, y^2 and xy for each sample and adding them to an appropriate running sum.

10. A method according to claim 9 wherein a leaky integrator is used to perform the running sum in order to address issues of numerical overflow.

11. A method in accordance with any preceding claim, whereby said weights are calculated so as to construct an omnidirectional combined signal when the total power in said first signal is below a certain value.

12. The method of claim 11 insofar as dependent on claim 4, whereby value a defaults to a value of 1.0 in the event that $\sum x^2$ is less than a prescribed minimum value.

13. A method according to any of claims 1 to 12, wherein the first and second signals are derived from signals produced by two spaced omni-directional microphones, a front and a rear microphone, and said predetermined direction is the forward direction along the microphone axis.

14. A method according to claim 13, wherein the second signal is provided by the difference between signals produced by the front and rear microphones, without the use of a delay element.

15. A method according to claim 14, further including the step of processing the second signal by means of an integrator element or an integrator-like filter before constructing the combined signal, thereby compensating for the attenuation of low frequencies and phase shifts introduced in the subtraction of the two omni-directional signals.

16. A method according to claim 14, further including the step of amplifying the signals produced by the front and/or the rear microphone before the step of constructing the bi-directional signal, to ensure an equivalent gain between the microphones.

17. A method according to any preceding claim, wherein said first and second signals are frequency domain samples.

18. A method according to claim 17, further including the step of calculating and applying the weights to several independent subsets of frequency domain samples, to

give different directional responses at different frequencies and/or to allow selective suppression of different frequencies.

19. A method according to any preceding claim, including the step of applying a frequency weighting function to said first and second signal before calculating said weights.

20. An apparatus for producing an adaptive directional signal, the apparatus including:

means for producing a first signal having an omni-directional polar pattern and a second signal having a bi-directional polar pattern; and

means for constructing the adaptive directional signal from a weighted sum of the first and second signals, wherein the weights are calculated to give the combined signal a constant gain in a predetermined direction and to minimise the power of the combined signal.

21. An apparatus according to claim 20, including means to provide said constant gain by imposing a constraint that the first signal weight and the second signal weight add to a predetermined value.

22. An apparatus according to claim 20 or 21, including means for calculating the weights by solving the following equation:

$$a = \frac{\sum y^2 - \sum xy}{\sum x^2 - 2\sum xy + \sum y^2}$$

Where:

a = weight for the first signal

$(1-a)$ = weight for the second signal

x = first signal sample

y = second signal sample.

23. An apparatus according to any one of claims 20 to 22, including means for calculating said signal weights for a series of frames, each frame having a predetermined length consisting of N first signal samples and N second signal samples.

24. An apparatus according to any one of claims 20 to 23, including a filter for filtering or smoothing the series of weights to minimise frame-to-frame variation in the calculated weights.

25. An apparatus according to any one of claims 20 to 24, including means for calculating said weights continuously for samples of said first and second signals.

26. An apparatus according to any one of claims 20 to 25, including a leaky integrator to perform a running sum on said first and second signal samples in order to address issues of numerical overflow system memory.

27. An apparatus according to any one of claims 20 to 26, including means for calculating said weights so as to construct an omnidirectional combined signal when the total power in said first signal is below a certain value.

28. An apparatus according to any one of claims 20 to 27, including two spaced omni-directional microphones, a front and a rear microphone, signals from which are used for deriving said first and second signals, and said predetermined direction is the forward direction along the microphone axis.

29. An apparatus according to claim 28, including means for providing said second signal from the difference between signals produced by the front and rear microphones, without the use of a delay element.

30. An apparatus according to claim 28 or claim 29, including an integrator element or an integrator-like filter for processing the second signal before constructing the combined signal, thereby compensating for the attenuation of low frequencies and phase shifts introduced in the provision of the second signal.

31. An apparatus according to any one of claims 28 to 30, including a means for amplifying the signals produced by the front and/or the rear microphone before the step of constructing the bi-directional signal, to ensure an equivalent gain between the microphones.